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Cuban Treefrogs (*Osteopilus septentrionalis*) in Illinois

John G. Palis [1], Steve A. Johnson [2], Jason R. Marks [3] and Mary B. Boehler [4]

Abstract

Cuban Treefrogs (*Osteopilus septentrionalis*) are non-native anurans that have established breeding populations throughout the Florida Peninsula, in New Orleans, Louisiana, and on Jekyll Island, Georgia. Cuban Treefrogs are considered invasive in the United States because they displace indigenous treefrogs and are a nuisance to people. Waif Cuban Treefrogs are occasionally detected in the United States and Canada far beyond their breeding range. We present details regarding three sightings of Cuban Treefrogs in Illinois from 2009 through 2021 that span nearly the entire north-south length of the state.

Introduction

Human-mediated dispersal of invasive species is a growing global environmental challenge (Vitousek et al., 1997; Liu et al., 2014). Through competitive advantage in human-modified landscapes, non-native invasive species can displace native species, resulting in loss of biodiversity and increased global homogenization of flora and fauna (Baiser et al., 2012). Vertebrates expanding their global range via human-mediated processes include 78 amphibian and 198 reptile species that have established populations outside their native ranges (Capinha et al., 2017).

With 64 established, non-native amphibian and reptile species (Krysko et al., 2019), Florida has become a gateway for dispersal of exotic species to the rest of North America. Some non-native species, such as Cuban Treefrogs (*Osteopilus septentrionalis*), are considered invasive because they displace native anurans and are a nuisance to people (Waddle et al., 2010; Johnson, 2017; Krysko et al., 2019). Cuban Treefrogs are large anurans (females attain a body length of 6.5 cm) native to Cuba, Bahamas, and Cayman Islands (USFWS, 2019). They were first detected in the United States at Key West, Florida, in the late 1920s (Barbour, 1931), and have since expanded their range northward throughout the Florida Peninsula. Breeding populations are now established as far north as Cedar Key on the Gulf coast, Jacksonville on the Atlantic coast, and Gainesville in central Florida (Johnson, 2017; Krysko et al., 2019). Given their propensity to use human structures and inhabit anthropogenic habitats, Cuban Treefrogs are inadvertently transported as stowaways in vehicles, boat trailers, and shipments of building materials and ornamental plants (Johnson, 2017; Krysko et al., 2019). As a result, Cuban Treefrogs have been detected in widely scattered locations in North America including several eastern, midwestern and western states, as well as Canada and Costa Rica (USFWS, 2019; González-Sánchez et al., 2021). Although these observations are generally thought to represent waifs (USFWS, 2019), breeding populations have become established in New Orleans, Louisiana (Glorioso et al., 2018) and on Jekyll Island, Georgia (Jarboe et al., 2019) by individuals likely originating in Florida. Here, we summarize observations of Cuban Treefrogs in Illinois.

Observations

Observation 1: One individual observed on 1 April 2009 in a Springfield, Sangamon County, Illinois, florist shop in a plant shipped from Florida. A digital image of the frog was emailed by Liz Lynch to SAJ, who identified the frog. The digital image of the specimen was lost during a crash of SAJ's computer hard drive.

Observation 2: One individual observed on 12 September 2013 in an ornamental plant purchased in Florida and transported to Zion Lutheran School, 408 East Jackson St., Marengo, McHenry County, Illinois (42°15'09.7"N, 88°36'16.2"W). The frog was collected by Katie Ostdick, preserved in alcohol, and sent to SAJ. Specimen deposited in the herpetology collection at the Florida Museum of Natural History (Figure 1: UF170857). This specimen was mapped by USFWS (2019).

Observation 3: One individual (Figure 2: UF 192241) observed by JRM at 1511 CDST, 23 May 2021, atop soil of potted fiddle leaf fig (*Ficus lyrata*) outdoors at a Menards home improvement store, 2500 Blue Heron Drive, Marion, Williamson County, Illinois (37°44'49.3"N, 88°57'33.8"W). The identification of this individual was verified by SAJ and Kevin Enge.

Discussion

In addition to breeding populations in Florida, Georgia and Louisiana, waif Cuban Treefrogs have been observed as far west

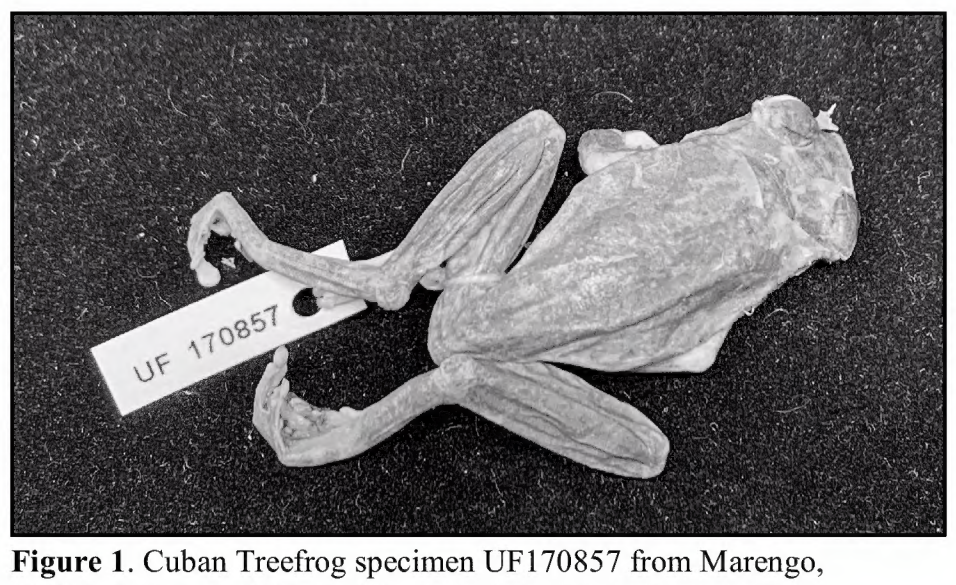

Figure 1. Cuban Treefrog specimen UF170857 from Marengo, McHenry County, Illinois. Photograph by Myles Domohowski.

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Figure 2. Cuban Treefrog (UF192241) in a potted fiddle leaf fig, Marion, Williamson County, Illinois. Photograph by JRM.

as Colorado and as far north as Ontario, Canada (USFWS, 2019). Modeling suggests that under current climate conditions it is highly unlikely that Cuban Treefrogs could establish breeding populations in the United States beyond their current range in Florida, coastal Georgia, and extreme southern Louisiana (Rodder and Weinsheimer, 2009). However, future climate scenarios suggest that climatically suitable areas may extend eastward from Texas along the entire northern Gulf coast and up the Atlantic coast to North Carolina (Rodder and Weinsheimer, 2009). Although climate change models suggest that Illinois summers will become much warmer (Hayhoe et al., 2010), freezing temperatures during winter make it unlikely Cuban Treefrogs could survive and become established in Illinois in the foreseeable future.

A present-day threat posed to Illinois amphibians by waif Cuban Treefrogs is the spread of disease. Cuban Treefrogs are hosts of the pathogens Ranavirus and Perkinsea (Galt et al., 2021). Infected Cuban Treefrogs transported to Illinois that subsequently disperse into areas occupied by native amphibians could spread pathogens that result in declines of the native fauna. We recommend that Illinoisans watch for additional Cuban Treefrogs that may arrive in ornamental plants. We also request that individuals who find a Cuban Treefrog in Illinois email an image with locality details (e.g., county, city, address) to SAJ and report their observation to https://eddmaps.org.

Acknowledgments

We thank Liz Lynch and Katie Ostdick for sharing their Cuban Treefrog observations with SAJ, Kevin Enge for independently confirming our identification of the Williamson County, Illinois, Cuban Treefrog, and Myles Domohowski for photographing the specimen in the Florida Museum of Natural History.

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Minutes of the CHS Board Meeting, August 13, 2021

A virtual meeting of the CHS board of directors via Zoom conference video/call was called to order at 7:41 P.M. Board members Stephanie Dochterman, John Gutierrez and Margaret Ann Paauw were absent. Joan Moore and Zachary Oomens attended as nonmembers of the board. Minutes of the July 16 board meeting were read and accepted.

Officers' reports

Treasurer: Rich Crowley went over the July financial report. Rich plans to set up a schedule as to when our tax filings and filings with the Illinois Attorney General are due.

Media secretary: Stephanie Dochterman reported that we are trending positively on our social media with an increase in followers. Efforts to follow and share content from other larger pages seem to be working.

Membership secretary: Mike Dloogatch read the list of those whose memberships have expired, and reported membership holding steady.

Sergeant-at-arms: Tom Mikosz reported that 86 people viewed the July 28 webinar.

Committee reports

Shows: The Peggy Notebaert Nature Museum is looking to start Cold-Blooded Weekends again. Volunteers must wear masks and follow new protocols. John Archer and Gail Oomens will hold a conference call with the museum on August 17 to discuss the new protocols.

The meeting adjourned at 8:35 P.M.

Respectfully submitted by recording secretary Gail Oomens

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Notes on Reproduction of Gopher Frogs, *Lithobates capito* (Anura: Ranidae), from North and South Carolina

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Abstract

I conducted a histological examination on gonadal material from 28 adult *Lithobates capito* from North (N = 20) and South Carolina (N = 8) consisting of 19 males and 9 females. The smallest mature male (sperm in lumina of seminiferous tubules) measured 73 mm SVL and was from March. The smallest mature female (mature oocytes) measured 67 mm SVL and was from February. Varying amounts of follicular atresia (spontaneous degeneration of oocytes) was noted in 56%, 5/9 of adult females. The ovaries of four females, two from February and two from March, contained postovulatory follicles (evidence of recent spawning activity). *Lithobates capito* enters spawning condition in February (South Carolina) and March (North Carolina), and also exhibits reproductive activity in early autumn (September) in South Carolina.

Lithobates capito (LeConte, 1855) ranges from southern Alabama, southern Florida, northeast to eastern North Carolina, including isolated records from Tennessee and southern Mississippi (Frost, 2021). *Lithobates capito* are considered Endangered, Threatened or of Special Concern in all states where they occur (Jensen and Richter, 2005). In the southern part of its range, *L. capito* may mate at any time of the year (Dorcas and Gibbons, 2008). Breeding occurs in ponds and also ditches and swamps (Elliott et al., 2009). *Lithobates capito* utilizes the burrows of gopher tortoises to avoid fires, predators and temperature extremes (Green et al., 2013). Semlitsch et al. (1995) reported the reproductive period of *L. capito* lasted only a few days. Most *L. capito* reproduction occurs during winter and early spring (see Dodd, 2013). In this paper I add information on reproduction of *L. capito* in North and South Carolina from a histological examination of gonadal tissues. The use of museum collections for obtaining reproductive data avoids euthanizing specimens and obviates the need for a collecting permit from state and federal authorities.

A sample of 28 *L. capito* from North (N = 20) and South Carolina (N = 8) collected 1955 to 1982 (Appendix) consisting of 19 adult males (mean SVL = 81.6 mm ± 8.0 SD, range = 73–103 mm) and 9 adult females (mean SVL = 85.2 mm ± 10.0 SD, range = 67–98 mm) was examined from the herpetology collection of the North Carolina State Museum of Natural Sciences (NCSM), Raleigh, North Carolina, USA. An unpaired *t*-test was used to test for differences between adult male and female SVLs (Instat, vers. 3.0b, Graphpad Software, San Diego, CA, USA).

A small incision was made in the lower part of the abdomen and the left testis was removed from males and a piece of the left ovary from females. Gonads were embedded in paraffin, sections were cut at 5 μm and stained with Harris hematoxylin followed by eosin counterstain (Presnell and Schreibman, 1997). Histology slides were deposited at NCSM.

There was no significant difference between mean SVLs of adult males versus adult females of *L. capito* ($t = 1.02$, df = 26, $P = 0.32$). Testicular morphology of *L. capito* is similar to that of other anurans as detailed in Ogielska and Bartmańska (2009a). Within the seminiferous tubules, spermatogenesis occurs in cysts which are closed until the late spermatid stage is reached; cysts then open and differentiating sperm reach the lumina of the seminiferous tubules (Ogielska and Bartmańska, 2009a). A ring of germinal cysts is located on the inner periphery of each seminiferous tubule. All 19 *L. capito* males in my sample were undergoing spermiogenesis. By month these were: February (N = 8), March (N = 8), September (N = 3). The smallest mature male (NCSM 11155), measured 73 mm SVL, and was from March. Wright and Wright (1933) reported adult males of *L. capito* measured 68–101 mm.

The ovaries of *L. capito* are typical of other anurans in being paired organs lying on the ventral sides of the kidneys. In adults the ovaries are filled with diplotene oocytes in various stages of development (Ogielska and Bartmańska, 2009b). Mature oocytes are filled with yolk droplets; the surrounding layer of follicular cells is thinly stretched. Monthly stages in the spawning cycle of *L. capito* are in Table 1. Two stages were present: (1) "Not in spawning condition " in which previtellogenic oocytes predominated and (2) "Ready to spawn condition" in which mature oocytes predominated. There were six females in the "not in spawning condition" in Table 1. Two of these females from February (NCSM 62329, 14774) and two from March (NCSM 3809, 7484) each contained postovulatory follicles, evidence of recent spawning (*sensu* Redshaw, 1972). One of them, from March (NCSM 7484) also contained residual mature oocytes. It is not known if these oocytes would have been spawned later in the year. Postovulatory follicles form

Table 1. Two monthly stages in the spawning cycle of nine adult female *Lithobates capito* from North and South Carolina. * = postovulatory follicles present.

Month	N	Not in spawning condition	Ready to spawn condition
February	3	1*, 1*	1
March	5	1*, 1*, 1, 1	1
September	1	0	1

Table 2. Months of breeding by location for *L. capito;* * as *Rana areolota capito,* ** as *Rana aesopus*.

Locality	Breeding period	Source
Alabama*	February–March	Mount, 1975
Carolinas	mid February to mid April	Beane et al., 2010
Florida	March 13 to November 3	Carr, 1940
Florida	October through May	Palis, 1998
Florida	September to April or every month	Krysko et al., 2019
Georgia**	late April to August	Wright, 1932
Georgia	January to spring, some in summer	Jensen et al., 2008
North Carolina	mid February to mid April	Dorcas et al., 2007
South Carolina	January to April	Semlitsch et al., 1995
Southeast	late winter–early spring or all year	Dorcas and Gibbons, 2008
No locality	throughout the year	Wright and Wright, 1933

when the ruptured follicle collapses after ovulation; the follicular lumen disappears and proliferating granulosa cells are surrounded by a fibrous capsule (Redshaw, 1972). Postovulatory follicles are short–lived in most anuran species and are resorbed after a few weeks (Redshaw, 1972). The postovulatory follicles in NCSM 14774 from February and NCSM 7484 from March were of recent origin as the lumina were filled with granulosa cells, whereas postovulatory follicles of NCSM 62329 from February and NCSM 3809 from March were older as the lumina were devoid of granulosa cells. The smallest mature female (mature oocytes) (NCSM 84136) measured 67 mm SVL and was from February. Wright and Wright (1933) reported adult females of *L. capito* measured 77–108 mm.

Atresia (spontaneous oocyte degeneration) is a widespread process occurring in the ovaries of all vertebrates (Uribe Aranzábal, 2009). It is common in the amphibian ovary (Saidapur, 1978) and is the spontaneous digestion of a diplotene oocyte by its own hypertrophied and phagocytic granulosa cells which invade the follicle and eventually degenerate after accumulating dark pigment (Ogielska and Bartmańska, 2009b). See Saidapur and Nadkarni (1973) and Ogielska et al. (2010) for a detailed description of stages of atresia in the frog ovary. Atretic follicles were observed in (56%, 5/9) of my mature female sample. Atresia plays an important role in fecundity by influencing numbers of ovulated oocytes (Uribe Aranzábal, 2011).

In conclusion, my data confirms *L. capito* reproduces in winter as reported by Dodd (2013) and Table 2. My finding of a gravid female from September confirms breeding may occur at other times as reported by Palis (1998) and other studies (Table 2). Histological examination of samples of *L. capito* from additional months are warranted to elucidate all aspects of the reproductive cycle.

Acknowledgment

I thank Bryan L. Stuart (NCSM) for permission to examine *L. capito* and J. C. Beane (NCSM) for facilitating the loan.

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Appendix

Twenty-eight *L. capito* from North Carolina and South Carolina (by county) examined from the herpetology collection of the North Carolina State Museum of Natural Sciences, (NCSM), Raleigh, North Carolina USA.

North Carolina, Brunswick: NCSM 4309, 11155; New Hanover: NCSM 3807, 3809, 3810, 3812, 3813, 6150, 6151, 7482–7484, 14771, 14772, 14774, 14777; Sampson: NCSM 22657; Scotland: NCSM 16257, 19874, 62329; **South Carolina,** Berkeley: NCSM 84136–84138; Hampton: NCSM 84109, 84114, 84116, 84117, 84123.

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A National Geographic Documentary, and a Final Tribute to Lonesome George and the *Crotalus atrox* near Ron's Den

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As none of you may remember, last month's column dealt with a gang of five of us discovering a new herpetological playground, and rescuing two Western Diamond-backed Rattlesnakes (*Crotalus atrox*) [*atrox* for short] from the bottom of a vertical mine shaft. Everything in that column—as well as this one—transpired as a result of my good friend and coworker, Ron Harris. In February of 1995, he had found an *atrox* aggregate den that had 30 rattlesnakes basking around its entrance. When I told him that I wanted to see it, he informed me that the key to finding this den was to first find a stand-alone giant of a saguaro cactus. He gave me some excellent directions on how to find this saguaro. According to Mr. Harris, this saguaro was the only one like it for miles in any direction. It was an excellent landmark. Find the saguaro and you will find the den. Once we found the saguaro, we were to turn right, or east. Within 100 meters of the saguaro, we would find his den. On 16 March of 1995, we set off to find the den that Ron had described. We found the saguaro. It was everything Ron said it was—and more. But there was no den 100 meters east of it. We improvised, and found something else worthy. If the reader wants to know more about that adventure, feel free to read last month's column (Repp, 2021). Other than mentioning the fact that our 16 March 1995 outing was on a Thursday, we are done talking about that fantastic day.

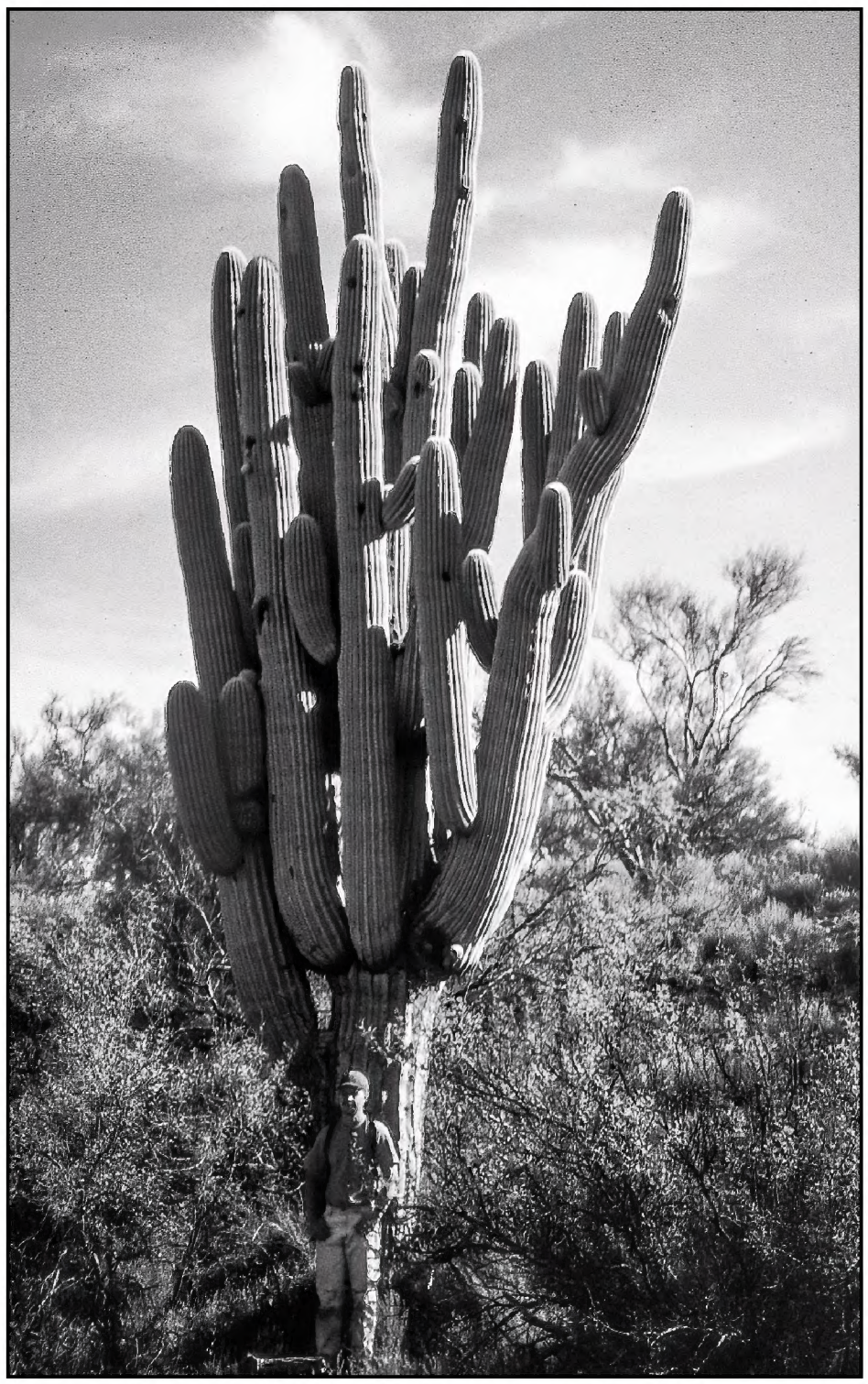

Figure 1. Erik Enderson stands next to the landmark saguaro cactus that I named "Lonesome George." See text for further details about the significance of this cactus. Image by Roger A. Repp, 19 March 1995. Unless stated otherwise, this and all other images are by the author, and the location for all is central Pima County, Arizona.

One constant between 1995 and now is the day that follows Thursday is Friday. And the Friday that followed 16 March found me back at work. I discussed what had happened the previous day with Mr. Harris. When I mentioned that we turned right at that saguaro of his and found nothing at all like the den that he had described, his normally cheerful countenance clouded considerably. He excused himself, promising me he would return shortly. He made a quick phone call, and less than five minutes later, he was back in my office blubbering all manner of apologies. We were supposed to turn *left*, not right, at that saguaro. Despite my assurances that all went swimmingly well on account of his mistake, he was still visibly verklempt with himself. I told him "no sweat," that we would give it another go. On Sunday, 19 March 1995, Erik Enderson, Pat Collins and I gave it another try. In a roundabout way, we found Ron's *atrox* den. Predictably, we decided to name the place "Ron's Den." While we did not see 30 *atrox* there that day, we did see a long and lanky male *atrox* place himself on top of what we guessed was his harem (Repp, 2015). What was *not* included in that 2015 column was the fact that I photographed Erik standing next to our landmark saguaro (Figure 1). I eventually named Ron's impressive landmark "Lonesome George." Any reader of this column who is not aware of the world-famous tortoise who carried the same name is encouraged to use their favorite search engine to learn all about him. The similarities of the isolated situation between these two giants are remarkable. We will speak more of this *magnificent* saguaro at the conclusion of this column.

The next visit to Ron's Den did not occur until 25 November 1995. On the one hand, it is *ridiculous* to think that it took so long to return. On the other hand, herpetologically speaking, I had so many fantastic places under watch that visiting a "new" *atrox* den seemed frivolous. I didn't even have time for the places that I had already found. While it sounds boastful, I am *amazed* with myself when I sift through my journals from this time period. It almost seems like a fantastic dream to me now. But unless I wrote my journals while sleeping, it wasn't a dream. I was a big kid, living the I-will-never-grow-old Peter Pan lifestyle. The only thing that I couldn't do was fly, although I might say that the thrills of discovery during this time period had me walking on air. I was without a doubt the walking, talking example of somebody who suddenly finds himself "living the dream," or "following my bliss." And while immersed in the total focus of seeking something new and cool in the herpetological realm, on this 25 November visit, a gang of

six of us peered into the depths of Ron's Den and witnessed a white-throated woodrat (*Neotoma albigula*) [packrat] at rest with its left paw against the flank of a large *atrox*. We also saw a *huge* Sonoran Desert Tortoise (*Gopherus morafkai*) inside this den. While a tortoise residing in an *atrox* den was nothing new, seeing a packrat who appeared oblivious to its own dangerous situation was completely over the top brand spanking new—both to me *and* the scientific world. After this first packrat, the frequency of observing such events increased to the point where such sightings became routine enough to publish (Repp, 1998; Schuett, Repp et al., 2016; Repp, 2018; Spencer et al., 2020).

Backing the train up a bit, in July of 1995, Dr. Steven Beaupre traveled to Tucson to speak to the Tucson Herpetological Society (THS) about his work with *atrox* near Scottsdale Arizona. I was of course at that presentation. More importantly, David L. Hardy, Sr., recorded and transcribed that talk, and published it in the *Sonoran Herpetologist.* That paper is in front of me as I write these words. Steve had been a casual acquaintance of mine since January of 1993. We accidentally wound up sitting at the same table, and here was this guy talking about *atrox* basking in January! Needless to say, we had much in common.

During the winter of 1995, I was contacted by Doug Meredith, who was a field tech working with *atrox* under the generalship of Dr. Beaupre "in a small regional park northeast of Phoenix" (Beaupre, 1995). The place was an absolute *atrox* Shangri La—the likes of which has never been equaled in all of Arizona. To give the reader a small example of the magnitude of the *atrox* population at this park, I am about to unload on you some of the fantastic things witnessed at Ron's Den. Well, Dr. Beaupre's regional park had at least five dens equal to or greater than Ron's Den—all in a very confined area. The problem was that the place burned to the nub in a fire that I believe was caused by lightning. Everything den-wise was wiped out. With the blessing of Dr. Beaupre (who had moved to Arkansas), Doug had made arrangements to work with a film crew there. But the fire destroyed that opportunity. Doug got my name and email address from Beaupre, and he contacted me. Would I be willing to take this film crew out? My answer was "yes."

The fire and subsequent contact by Doug is how it came to pass that in the winter and spring of 1996, I assisted the Oxford Scientific Film Company in their endeavors to film combat and mating behaviors of *Crotalus atrox*. They were working with National Geographic on a film that would be called *The Sonoran Desert: A Violent Eden.* While most animal behavior in a nature documentary is normally staged with captive animals, neither they nor I could find anybody keeping *atrox*. I told them that the possibility of filming *atrox* mating and combat in the wild was highly probable at many of the dens that I had found. But if they were going to do that, they *must* follow my protocols. Said protocols were *pounded* into their heads, the most important being: *They must let nature take its course during the filming process at the dens. The instant that they started trying to manipulate the snakes to do their own bidding, said snakes would all leave the den—perhaps never to return—and the show would be over*! My personal mantra at the time was "hands-off herping." Their mission (should they choose to accept it) was to be "hands-off-filming." They were interested enough to at least consider the

Figure 2. Ron's Den. This aggregate den of Western Diamond-backed Rattlesnakes (*Crotalus atrox*) was the location of a National Geographic documentary film. The date this image occurred was 2 December 1995, roughly 3 months before the filming began. There were 8 *Crotalus atrox* visible inside the den this day.

possibility. We began the cautious process of building trust by visiting some aggregate dens under my watch. On 26 January 1996, I guided cameraman Keith Brust and an administrative assistant known only to me as JC to Ron's Den. JC drove their company SUV. At my insistence, Keith took the front seat. I wanted to be sure that both got their bearings, for there was no way in hell that I would be drawing any maps to any of my locations. When we were roughly a mile away from Ron's Den, my back seat perch afforded me a great view Keith's head swiveling in every direction imaginable. He then asked the question that made my heart sink a little: "Are there any saguaros at this den of yours?" As previously stated, other than Lonesome George, there was not a single saguaro to be had at or near Ron's Den. And Lonesome George was not visible from it. But once they saw Ron's Den, with its natural, open amphitheater setting, and *atrox* coiled and ready to emerge from every crack and cranny, they knew this would be the place to film (Figure 2).

It would be easy (and *great* fun) to describe in detail what else happened between the film crew and their persnickety, over-protective herpetologist in the months that followed. Perhaps a future column will deal with all that? For now, I will simply introduce the reader to the crew from Oxford Scientific Film Company [OxSci]. We have already mentioned Keith and JC and their roles with OxSci. There was another cameraman named John Brown, and their producer and scriptwriter was Sean Morris. While I have the utmost respect for this crew, they are merely human beings. They were *excellent* at their craft, but they are not the stars of this column. For that matter, neither am I. Nope! The *real* stars of this production were the *atrox* at Ron's Den. Actually, that's not quite right. The other *atrox* were merely a supporting cast for the *real* star of the show. We speak of the absolute king and reigning monarch of Ron's Den, the alpha-male *atrox* who gave Erik, Pat and I such a smashing first impression with our inaugural visit to the place in 1995. Though we have published the next image to appear in this column in the *Bulletin* on two previous occasions, it remains the best available image of *the* alpha-male *atrox* who dominated Ron's Den for over ten years. Hence, we show it again. During the early phases of filming the action at Ron's Den, the crew of OxSci named this snake "Tyson," as this snake demonstrated the same propensity

Figure 3. Commanding center stage for not only this photo, but also this article and the film described in the text is a *Crotalus atrox* whom the film crew named "Tyson." 19 March 1995.

as his namesake for quickly delivering a winning blow to any would-be contender. Mike Tyson the fighter was at his peak during this time period, and so was Tyson the snake. To be sure, Tyson was not the biggest snake at Ron's Den. He was over four feet long in total length, and was leaner in build than the other large *atrox* who were his size in the vicinity. Truth be told, Tyson was a poor choice of names for this snake. Tyson the fighter had a squat and powerful build. The lean build on Tyson the snake more closely resembled Ali than Tyson. But name him whatever you want, every inch of Tyson the snake was powerful, and his disposition was plumb mad-dog mean. He was on constant patrol at his den, and he was looking for either love or trouble with every move he made. Some of his actions will be described down the line, but when you think of Ron's Den, think of any school playground that has its resident bully. To the *atrox* at Ron's Den, Tyson was that bully. Nevertheless, as a result of Tyson dominating every scene in the film, a star was born (Figure 3).

Ron's Den not having any saguaros was a *big* problem for this production. But everything else about it was perfect. Of all the places I showed OxSci, Ron's Den was by far the best place to film the wild segments of their production. But the problem of there not being any saguaros there drove them bat-shit crazy. To solve that problem, the ambitious and clever crew took a scene right out of *Blazing Saddles.* In that Mel Brooks movie, the townspeople of "Rock Ridge" build a replica of Rock Ridge in order to confuse the bad guys. In the weeks prior to beginning to film the *real* wild behavior, OxSci busied themselves by building a replica of Ron's Den. They used chicken wire with a generous slathering of papier-mâché over top, and painted the whole shooting match the same drab gray and tan colors of the den. They built this set in two parts, so that it could easily be transported to various locations at whim. They next "imported" a bunch of *atrox* from the local fire departments to be the "stars" of their replica den. (At that time, local fire departments were often tasked with removing unwanted rattlesnakes from private residences. They were *always* happy to get rid of these, as it saved them the trouble of euthanizing them.) OxSci also imported a *very* competent local herpetologist to help them wrangle these snakes for the staged shots. We speak of Randy Babb. I met Randy for the first time at their studio. While we had never been eyeball to eyeball, we both had been hearing of each other for years. We were both heavily involved as ambassadors of herps to the public for years before actually meeting. When Keith introduced us, the discussion between us must have sounded like something out of the Herpetological Mutual Admiration Society. From my end, I was happy to see somebody like Randy wrangling snakes for the production, and Randy was ecstatic that OxSci would be working with me for the wild segments. And OxSci solved the problem of no saguaros at Ron's Den by simply moving the replica of Ron's Den to a place where saguaros flourished. There were many sequences in the film where the *atrox* are seen inside of the den, looking out. The imported *atrox* always had a great view of a saguaro-studded landscape in these segments—and so did the viewers! And any of the segments where the wild *atrox* appeared were closely cropped so that the audience would not see how butt-ugly the setting of Ron's Den actually is.

Thus it eventually came to pass that team OxSci were positioned at Ron's Den to film whatever the place would throw at them. They remained patiently at their post for an entire week. They stayed right there, day in, day out, until the last dog died. At my insistence, they choose several days to either side of 19 March for their effort. Experience had taught me that March 19 was the Holy Grail, can't fail time period for mating to occur. The deal between OxSci and me was that I would not visit Ron's Den while they were filming. That was best for both sides of the equation. I wanted them to get the best action images possible while they were there. And should I come blundering up to the place when something cool was developing, my appearance alone might be enough to ruin everything. Where I was concerned, staying clear of Ron's Den was not a problem at all. There were plenty of places to go, and some of them had what Ron's Den did *not*! We speak of overwintering Gila Monsters (*Heloderma suspectum*). While OxSci took care of my light work, I was wallowing in Gila Monsters.

Meanwhile, getting back to OxSci and Ron's Den, Sean called me every night with reports on what they were seeing and filming. Their confidence increased with each passing day. The call that I received on the evening of 19 March was particularly gratifying. I had been telling the crew that March 19 was *the* magic day, and if they could only film one day, that was the one. They grew so accustomed to hearing that noise that they actually started to jest with me about it. But there was no jesting in Sean's voice with that late night 19 March phone call. He must have said "*You were right*!" at least ten times. This and other discussions with Sean were exactly the sort of thing that I was hoping for. Having them at Ron's Den allowed me to maintain a damn good presence there—much better than if I had been there myself! They were my eyes and ears at that location. However, I did desire visiting the place at least once during the filming. Knowing that Sean was in a good mood with his March 19 phone call, I asked if I could visit, and maybe bring a couple friends. He was receptive to that request. The date he selected for this visit was 22 March, which was to be their last day of filming there.

Hence, on 22 March 1996, Tom Caldwell (father of Dennis, who has earned mention many times in these columns), drove the future tortoise conservation master Taylor Edwards and me in his Toyota 4Runner to our usual parking spot near Lonesome

Figure 4. The *Crotalus atrox* den, located about 150 meters east of where the film crew was stationed, at which combat occurred on 22 March 1996.

George. (We had evolved in our approach to getting there. There was no more of this potato-patch parking or compass-following bullshit. We now simply parked and hoofed down a wash for a distance of roughly 500 meters westward to get to Ron's Den). While quietly weaving our way through the cat claw and white-thorn acacia that lined the sandy wash bottom, our ears detected the unmistakable buzz of an alarmed rattlesnake. The sound was emanating from somewhere off to our right, and a split second later, the sound directed our eyes to the source. About 30 meters up the moderately sloping embankment, a roughly one-meter-long adult male *atrox* was viewed sprawled on the ground in a lazy horseshoe shape. His head was slightly upraised in a semi-defensive fashion, and his rattle was cocked upward slightly, sounding off in a most half-hearted fashion. We froze in our tracks, the snake soon stopped rattling, and began nosing about the outer perimeter of a packrat midden. The midden was comprised of stacks of twigs that were sprawling out of the base of a circular slab of limestone. The formation and midden were all under the open canopy of a mature mesquite tree (Figure 4). As the snake in view began to tongue-flick and slink his way uphill toward an entrance to the midden, Taylor whispered that he heard a rattle sounding off. But the tail on the *atrox* in view was not shaking! Our eyeballs locked as I removed my camera from its pouch, and I quietly whispered "Let's stick around a minute." The other two heads nodded in agreement. (I was *really* in good company this day.) Now the rattlesnake in view began to slide into the midden, and Taylor suggested that the rattle inside the midden was beginning to intensify. As I *still* could not hear it, I asked Taylor to point to where the sound was located. When he pointed to roughly the upper center of the midden, I quietly slipped up and halted roughly three meters downslope of the midden. Taylor was right behind me, while Tom was content to watch from his vantage point in the wash. The snake in view was halfway into the midden, and I was getting ready to take a photo of the tail for future identification purposes. Suddenly, the snake that was entering the midden swiftly withdrew, but he appeared to be intently watching the entrance to the midden that he had just tried to enter. And then—*shoom*! In the blink of an eye and out of the blue, a second *atrox* jetted straight up from the depths of that midden. He stood ramrod straight and proud--well over half of a body length tall. Lickety-split, the *atrox* who had been entering the midden rose to accept the challenge—***and it was on!***

Without thinking (*and what was I thinking*?) I commanded Taylor to get the film crew. The request was silly right from the start, as the poor guy had *no idea* where the film crew even was! And the request not only denied Taylor the chance to witness what remains the best fight between vipers ever witnessed by the human eye, it also pissed away a God-given opportunity for me to be in the right place at the right time to photograph—from beginning to end—a hard fought battle between two fully aroused, testosterone-infested rattlesnakes. I have seen, both in person and on film, many bouts between vipers. Were I to put everything else I have seen to music, it would be to the tune of the Blue Danube Waltz, or even the Volga Boatman. What was going down directly in front of me this day was more like the William Tell Overture—with a couple of "Hi Yo Silvers" thrown in for good measure. The ascent action was lightening fast, the body wraps so fast that they were a blur, and the hard-hitting body slams had both snakes slamming to the ground with audible "whumps." While grappling on the ground, the pair whipped about like severed fire hoses under high pressure. At times, each was trying to climb up the body of the other. When that happened, the pair looked like a drab barber pole, the spirals leading to nowhere yet seemingly in perpetual motion toward the heavens. When they grappled on the ground, I could actually hear their scales grinding against each other. With the first ascension, I belly flopped to the ground, and was firing away uphill. After a short while, both snakes tumbled out of the underbrush above me, and righted themselves again. At that point, they were on open ground, less than a meter way, and rose into a full ascent posture again. Ascent, whump, ascent, whump. again and again some more! (Figure 5).

Meanwhile, after being brusquely informed of the film crew's whereabouts, Taylor did his best imitation of a rabbit, dodging and weaving through the harsh vegetation at high speed. When he broke into the vast, bowl-like clearing that contains Ron's Den, he saw John Brown and Keith Brust crouched over their massive cameras. He then ran toward them, hissing "P-s-s-s-t, p-s-s-s-t, this way," at the two of them, while beckoning them to come hither with the universally understood sweeping arm gesture that indicates "follow me." They both looked up from their cameras, no doubt wondering "Who the eff are *you*?" But to their credit, they snagged their heavy cameras and followed Taylor. Having seen Taylor lead a group via his Rudy the Rabbit cross country sprinting methods, I can only imagine John and Keith blundering along at full tilt behind him.

I don't know how long it took Taylor to retrieve these two and get them there. I only know that it wasn't long enough. Just as I was getting good, clear shots of the fierce, fast and furious action occurring just off to my right, my viewfinder was suddenly filled with John Brown's ass. He ran directly in front of me, with his camera low to the ground. The snakes *immediately* broke apart. One jetted downslope, while the other remained in a half-hearted ascent posture, looking confused and stupid. I believe this one was the intruder snake, who seemed to shrug the shoulders that he didn't have before crawling back up to the midden. He watched us from that vantage point, too stupefied to even rattle. Just like that, what should have been and could have

Figure 5. The three best images that the author got of an incident of combat that occurred outside the den pictured in Figure 4. 22 March 1996.

been the best damned knock-down dragged-out combat bout ever witnessed by modern man morphed into something completely FUBAR. There was little else to do but head for Ron's Den. While on the way there, we could not help but notice little strips of man bacon dangling, like so many bloody dingleberries, from the pernicious acacia and hackberry that choked the pathway of the wash. Taylor's charge must have indeed been a painful experience for our two cinematographers.

As soon as we got to Ron's Den, Keith and John resumed their positions. I was rather amazed at the angle that they approached in filming the den. Rather than squaring their cameras off to the apron in front of the den, they set up so that they were filming across the apron in lengthwise fashion (Figure 6). So surprised was I with this development that I *almost* Roger Repped them in a big way. My mental voice ("mental" being both literal *and* figurative here) screamed "Here, now—what the *hell* are you guys doing? Move these cameras over *here*, and film this den broadside like a proper cameraman would!" But for once, I was wise, and said nothing. I was soon to learn who the *real* camera people were—and one of them was *not* me! (Although I will add with a high degree of smugness that *my* combat experience clobbered anything that they got for their final product. I had offered—for a fee of course—to be their "rover," that is, a guy who kept moving between dens to alert them to developing behaviors. But **N-O-O-O!** They couldn't afford me. Har-DE-har, pikers!)

It was not until the evening of 12 April 1995 that I saw the OxSci crew again. They wanted to see my combat images, and also wanted to show me some of their footage. Thus it came to pass that Sean, Keith, John and I gathered at JC's apartment. Those of us familiar with this time period will know what a hassle it was for me to bring my slide projector to this meeting. As they had already set up their reel-to-reel projector, they went first. To quote Howard Carter of King Tut fame, his first words upon peeking into the tomb were that he saw "wonderful things." But "wonderful things" doesn't even begin to adequately describe what these crackerjack cinematographers had captured with their camera. I dare to even say that they had captured behaviors that have never, before or since, been documented on film *or* by science.

The opening segment of what I saw was courtship and mating. This was something that Keith and John scored at another den that I had shown them. They had actually filmed this on 10 March—which I mention *only* because it is a highly citable date. My notes from this evening boldly state "Total insertion filmed and blown up to full screen." Sean jokingly said "We could get

Figure 6. Bring out the big guns! (Left) Keith Brust and (Right) John Brown poised to capture the action at Ron's Den on film. See text for details. 22 March 1996.

arrested for showing this," and I had to agree with him. There is nothing that I would love to do more than describe what I was seeing to the reader—but then ***eye*** would be the one arrested. In the end, most of this wound up on the cutting room floor. But I am pleased to say that enough made it into the final product to have made their effort pay off. The packrat made some cameo appearances in what I saw this night. But a notable change in demeanor had swept over him with the changing of the season. He was now on full alert, and was flitting about like a fart on a hot griddle. There was no more of this sleeping-on-top-of-the-rattlesnakes stuff. He was now one wary rat, who furtively dashed about from entrance-to-entrance, looking ahead and behind while on the move. When he hesitated to catch his breath, his head was on a swivel, and he was twitching so nervously that he seemed to vibrate. Why he stayed at that den is a mystery, but for whatever strange reason, they usually do. At one point, the *massive* tortoise emerged from the east entrance of the den. At first, the camera followed him as he began to lumber slowly downslope and away from the den, but then the camera panned left and captured Tyson and an equally sized male challenger rise into the air for several seconds. The two snakes stared at each other, performed a few half-hearted wraps, and then Tyson gave the challenger a brief chase across the apron of the den. Sean gave a laugh at that point, and said he was so busily filming the tortoise that he almost missed the *atrox* action. But through it all, Tyson commanded center stage. He was omnipresent, in nearly every frame, always on the move, alertly and aggressively taking note of every nook, cranny and individual snake on his turf. He was in complete command of his world. To be sure, there was mating and fighting, but that is not what got me out of my chair. What got me out of the chair was the tail waving that was transpiring. In one sequence, Tyson is sniffing out a cluster of perhaps 15 snakes, who were all out basking on the open apron just south of the den. As Tyson starts to crawl on top of the pile, four tails rise out of that pile, and began waving lazily back and forth. Tyson zeroed in on one of those tails, and used his snout to root out the snake that was attached to that tail. This snake was another large male, but the excellent footage clearly showed that his rattles were tapered—a younger snake, perhaps an "upstart" who might one day replace Tyson. But today was not that day. Having had a lot of time to think about this, it is my hypothesis that these snakes were talking to each other. I will speak more of this soon, but for now, the reader is asked to let your madness mingle with mine. Whatever the upstart said, Tyson did not like it. He nosed that snake out of the pile. The upstart fled the scene, which should have been a wise course of action. He headed downslope, jetting toward the sandy wash that is positioned south of the den. But Tyson wasn't going to let him off that easy. He was hot on him, and quickly overtook him. Several euphuisms come to mind to describe what happened next. The two best are "Tyson was on him like white on rice," or, better yet, "like stink on a monkey." ("Cheap suit" would also work here). Even though both snakes were of near-equal size, Tyson chased that upstart down, sprawled over top of him, and proceeded to grind him into the sand. As this was happening, the upstart began waving his tail with increased vigor, as if in sign of total surrender. The angle of the camera was excellent for this event. Tyson's head, as well as that of the upstart, was expertly focused, looking straight into the camera. The bodies of both snakes trailed into the background, but were nevertheless immaculately in focus. Everything was in focus, right down to the grains of sand that the upstart was being forcibly half-buried into. When I saw this sequence, I was out of my chair, exclaiming "Whoa, can we see that again?" One of the four film crew members present—I believe it was Keith—then asked me "Is that tail waving a sign of submission?" I had to admit that I had never seen that behavior before, but submission certainly seemed like a likely explanation.

During the entire half-hour mini-production witnessed, there were several other instances of tail waving, or tail signaling, that transpired. The sad part is that it all wound up on the cutting room floor. The film crew was paid, and paid well, to produce a special that was not concerned with anything but what the producers wanted. They wanted combat, they wanted mating. They got that, and they showed that, and the rest is history. It's gone—forever! At the time, I would have *never* guessed that they would cut all of this stuff out of the actual film. I just assumed that most of it would be included. What Tyson and the other *atrox* at Ron's Den were showing us were highly-advanced social behaviors the like of which has never been documented—before *or* after. I did not see the actual production until six months after. At that point, I scrambled to get what was cut in my hands. But by them, it was too late—it was history. *I'm getting pissed just thinking about it! What were they thinking? Tyson grinding that upstart into the sand was the most thorough snake-to-snake ass-kicking I have ever seen! Why not show it? Was it too graphic? WTF?*

But what was *not* history, what was *not* gone, was the indelible impression of things to watch for in the future. Sadly, there were only two more incidences of tail signaling left to be seen before I went off to other dens and other ventures. One incident is barely worth mentioning, as it could be (and was) interpreted as a confused male getting a whiff of a female's pheromones on another male's tail. But it is hard to suggest anything *but* male-to-male communication in tail signaling with the other observation. We will speak of that soon.

After seeing OxSci's footage, it was time for me to show my stuff. That took all of five minutes. To be sure, I showed them everything I had, and you have only seen the three best. The first several images that I took are actually the best behavior-wise, but my camera focused on the brush that was in front of the snakes. But the blurs behind the brush still clearly show what was going down. At the end of my bit, Sean hung his head, but in a very solemn and earnest fashion, shook my hand and said: "Congratulations Roger, you got it!" I of course assured him that it was more luck than brains. But he was right. Luck, brains, whatever! I got it! When all is said and done about OxSci's effort and the resulting film, it earns a *huge* thumbs up. But it is downright tragic that the best of what they so exquisitely captured wound up being discarded. If nothing else, it could have all been used on future NG projects, or sold to any number of other film companies who were beating my door down seeking the very sort of thing that they already had in hand. Sigh . . .

On 20 March 1998, I was once again viewing Tyson at Ron's Den. There was no longer a film crew involved. It was just my friend Robin Llewellyn and me. On this day, Tyson was coiled

Figure 7. Tyson in ascent moments before body slamming a rival male, who must have said the wrong thing. Note the action that is going on inside the den behind Tyson. He appears to be hooking tails with two other *atrox*. This event happened on 20 March 1998.

on top of a cluster of several other *atrox* at the easternmost entrance to the den. The anterior two-thirds of his body was in the sun. The distal third of his body trailed off into the shade behind him. His tail was groping into the cluster of *atrox* beneath him, seeking something—*anything*—to wrap. While he was occupied doing this, a smaller adult male *atrox* emerged from the depths of the den, and coiled beside him. Tyson immediately began to chin rub on his coiled form, and showed great interest in the new arrival. In almost nonchalant fashion, said new arrival pulled his tail from beneath his coils, and methodically waved it back and forth. The best way to describe the motion of his tail is to say that it lazily flopped from side-to-side. His tail was positioned in such a way that it was directly in front of Tyson's face. Tyson's reaction was swift, and fierce. He ascended half his body length above the new arrival, and came crashing back down on top of him (Figure 7). The thud as Tyson hit that snake was audible—it was a hard smacking! Without further encouragement, the new arrival shot back down into the den, out of sight in one second flat. Tyson gave chase for half a body length, and then returned to the cluster of snakes beneath him as if nothing at all had happened.

I am not afraid to throw out my interpretation of the "discussion" that transpired between the two snakes. Fear of ridicule is what keeps those of us who know our subjects best from interpreting any behaviors that we see. I am all in favor of performing testable hypotheses to prove things in an acceptable scientific manner. But sometimes, that is simply not possible. It would help if we knew how vision plays its role with *atrox* specifically, and other species of snakes in general. I ask myself questions like why did *atrox* evolve to have white and black banded tails? Perhaps we need to ask such questions of ourselves, like why are our own signal flags black and white? Could it be that tail color is playing its role in *atrox* communication? Yeah—I for one think so! But how do we prove that? And what about the pheromones involved? What do we do, investigate this phenomena with some sort of high-tech sniff-o-meter? While that last sentence ended in jest, that is exactly what we need. We need to learn how to see with our own sense of smell before we can ever hope to prove there is a language involved with snakes.

Until that time comes, I'm going to interpret what I see to the best of my ability. Witnessing that male crawl out of the den to settle beside Tyson was a highly fortuitous occurrence. The timing was impeccable. The new male likely settled in because there were a pile of females nearby. Did he think that since there were plenty of ladies in the vicinity, Tyson would be willing to share? *That's funny*! Tyson's initial reaction indicates that he probably thought that this new arrival was a female, and began lavishing his amorous attentions on him. By waving his tail at that point in time, the new arrival told Tyson "No, idiot, you got me all wrong. You can't mate with me—I'm a male!" Rather than respond with his tail (which was occupied performing other important matters), Tyson used body language and violence to let his thoughts be known. "Oh, really? You're another male? Then get outta here!" (Insert audible thump here). And if I'm going to interpret what happened next, I may as well have some fun with it. The new male then said "Yipe! Yipe! Yipe!" And then he went "wee wee wee all the way home." However simple the dialogue may have been, these two snakes talked to each other. A message was delivered, loud and clear, and received. Tyson said "get," and the male "got." This author would be remiss in his duties if he did not inform the reader that a less colorful recounting of the tail-talking (caudal conversations?) also appears in two books (Schuett, Clark et al., 2016; Bradshaw, 2017).

Cool behaviors witnessed at Ron's Den tended to come in bursts. Since I have just described something that happened on 20 March 1998, I'll toss in something else witnessed this day. Two *atrox* were coiled roughly 30 cm apart. Both were adult snakes, the one on my right was a male, and the one to the left was a female. They were directly on the den apron, roughly 5 cm from the central entrance to the den. When I gently moved some wild mustard out of the way with my walking staff to get photos, the male broke out of its coil, and encircled the female. I compare what that male did next to an expanding and contracting doughnut. That is exactly what happened here, several times, very rapidly—think "blink-of-an-eye" quick. I did not count how many times the contractions happened, but as soon as it stopped, both snakes immediately jetted into the den and out of sight. Was this some sort of warning behavior? I have never seen anything like it since, but share a photo along with the written account in the event that somebody else has (Figure 8).

Figure 8. A male *Crotalus atrox* has just encircled a female. While this appears to be courtship, the author explains that it might be something else. Image taken 20 March 1998.

But just when the reader thought it safe to proceed with this article, we bring back tail signaling for one last encore paragraph. In October of 2016, this author was invited to present at the *great* Midwest Herpetological Symposium. While I think my performance was excellent, I have not been invited back. Perhaps it was on account of my exorbitant liquor reimbursement request? No matter—it was fun while it lasted. Bree Putman was also there, presenting her work with the relationships between squirrels and Southern Pacific Rattlesnakes (*Crotalus helleri*). (Incidentally, the situation between squirrels and *C. helleri* are somewhat similar to the packrats and *atrox* described early on in this column). In one of her video clips, the audience saw two *C. helleri* coiled in diagonal corners of the frame—top left and bottom right. The snake at the top pulled its tail from under its coils, and performed the same lazy to and fro flopping of the tail as described above. After about ten seconds of this, both snakes bolted out of the framework of the film. It took every ounce of restraint that I posses to remain in my seat. I wanted to stand up and shout "***Whoa! I wanna see that again!***" But I waited until the question and answer session before doing that. Dr. Putman was gracious enough to show it again. I *think* she cautiously interpreted the behavior to be one snake telling the other: "It is time to leave." And if she didn't say this—I do! The second showing of the film clip inspired a brief discussion with the audience. Somebody seated behind me commented that they had also seen such behavior with colubrid snakes. I believe that this person was part of a contingent from the Minnesota Herpetological Society. I would *sure* like to talk to this person to find out more. Snakes might be talking to each other, but sadly, herpetologists seldom do. If anybody reading these words wants to talk about it, hey! Don't be shy—throw me a bone!

I will share one more set of observations before closing the books on Ron's Den. On 8 March 1997, Jeff Moorbeck, Jennifer O'Leary and Erik Enderson joined me for a thorough sweep of Harris Flats. Ron's Den was *always* included in these sweeps, as was everything else east of Lonesome George. What happened at Ron's Den on this day is a suitable ending to the place, for it all added up to a grand finale of sorts behavior-wise. We saw 20 *atrox* at Ron's Den this day, which—other than Ron Harris's dubious report of 30—was the most ever seen there. A packrat was also observed deep in the east entrance, and he was playing hide-and-seek with the *atrox* by circling the *huge* tortoise, who was also home on this day. With so much going on there, we visited the place twice. My notes indicate that we were there from 1142 to 1230 hours, and again from 1458 to 1618 hours. For both visits, we hung out in the shade that was a fair distance downslope, and moved up to take photos whenever inspired to do so. An exact quote from my notes for this day is in order. With the morning visit: "Tyson is there, and was behaving in champion style. Very alert snake, jerking and crawling all over the densite . . . " And for the afternoon: "Upon our arrival back at 1458, he [Tyson] was firmly entrenched in displaying courtship behavior." I will continue with what I wrote this day, but there is a *glaring* inaccuracy with the words. I did not know, or even envision in my wildest imaginations, that male *atrox* would sometimes try to mate with other males. Dave Hardy was the first to tell me of this, but he called it "male-to-male rape." I can't bring myself to call it that. And while I care less than nothing about what consenting adult humans do privately; neither can I bring myself to call Tyson "gay." It is my opinion that in cases like this, some males have vigorously courted females, and there is likely a generous dose of female "eau de cloaca" still clinging to their tails. Once a horn-dog of a male like Tyson gets a whiff of this, heaven help whoever that scent is coming from! I have many angles of this courtship in my possession, and everything I see indicates that Tyson is attempting to mate with another male. We continue with my notes: "Upon our arrival back at 2:58, he (Tyson) was very firmly entrenched in displaying courtship behavior. He had the female's (male's!) tail wrapped, and was forcefully jerking it around, whilst chin rubbing all over her (his!) body. As far as I could see, coitus had not occurred." We are back to live action, but will soon plunge back into 1997 again. Tyson's courtship was occurring in the west entrance to the den. Said west entrance averages roughly 20 cm tall, and is perhaps 1.5 m long east to west. It goes very deep into the ground, certainly more than the three meters that I can see with my mirror and reflected sunlight. Tyson's courtship was occurring on the western edge of the crevice. While that was going on, a much smaller, younger male was viewed coiled with its body tucked tightly against the east side of the embankment that dives into the eastern edge of the western gash / crevice of Ron's Den. As he was just sitting there doing nothing and being totally unremarkable in every way, I had my camera trained on Tyson. We now go back to my notes from this day: "One male snake was scared by my attention, as he moved away, he had two females that he was hiding from Tyson." The wording here is not very good. First of all, I say nothing about turning my camera on him as he began a very slow retreat into the depths of the west gash. But that is what I did, and we will let the images and captions explain the rest of this story (Figure 9).

On 9 March—one day later—Dennis Caldwell and Chris Wolner visited Ron's Den. While I was not there, I *gratefully* received an extremely rare email from Dennis that described some of what he saw. What is even more incredible than an email from Caldwell is the fact that I actually inscribed his report directly into my own notes. They saw 13 *atrox* at Ron's Den on this day. According to Dennis, the "big event" was Tyson trying to mate with a larger male. An exact Dennis quote will put a bit of an exclamation point on what I have been saying about Tyson, as well as the many other magical moments that occurred at Ron's Den. Putting it all in the words of the normally taciturn Dennis Caldwell: "Tyson was just throwing his tail everywhere. When he would connect with another tail, he would seize it and try to mate with it. When he connected with the tail of the larger male, he wrapped it and tried courtship. A chase scene happened, and the larger snake went to the back of the den. Tyson hunted aggressively all over, and then got distracted by a female. That Tyson is a *real* asshole!" Yup! Tyson's brutish mannerisms do not exactly reflect proper upbringing, and one can hang all manner of negative monikers on him. We will get back to him shortly.

Since I'm sure that the careful reader has just already gazed upon Figure 9 mentioned above, I ask that you direct your eyes to the right side image in this set again. While Tyson was occupied playing with his boyfriend in the left-side image, the slowly retreating male in the image to the right, whom we will name

Figure 9. (Left) A very confused Tyson is photographed courting a male snake. (Right) While Tyson is playing with the boys, a young male has coiled a scant 1.5 meters from him. The male snake breaks coil as a result of the author's intrusive camerawork, and reveals two females that he has been shielding from Tyson and other males. Images taken 8 March 1997.

"Tricky Dick," reveals that he had cleverly coiled in front of two females. (There may actually be three). He did so in such a way that the females were hidden from both Tyson *and* me. But my presence spooked him, and as he crawled off, I swung the camera his way in order to get images of his tail. With *atrox*, their tail pattern can, at times, be used to identify them. Tricky Dick's tail was rather remarkable in that it had six equally spaced black bands. Note also that though this image is *terrible*, the rattle count can easily be picked off. It was only because he moved that I took the photos of him, and I was not aware that he had positioned himself in front of these girls until *after* he started to move. Now comes the good part. On 14 March 1997—six days after first identifying Tricky Dick and the girls he was presumably hiding from Tyson—I took Dr. Gordon Schuett to Ron's Den. On this day, while Tyson patrolled the den in his usual tyrannical fashion, good old Tricky Dick was viewed in coitus with the fine young lady viewed coiled to the right lower corner of the right side image of Figure 9. If the reader did not notice that there is an arrow pointing this girl out in Figure 9, please look again. Tricky Dick and "Arrow Girl" were in the last stages of mating on 14 March. I knew who they were as soon as I saw them. Arrow Girl was moving eastward, and Tricky Dick was crawling backward in order to both keep up and keep in. They were roughly five meters away from Ron's Den, which was apparently far enough away to escape Tyson's attentions. Arrow Girl can and should be grateful to Tricky Dick for the cunning he displayed in keeping her away from Tyson. I shudder to think what would have happened to this sweet young *atrox* if Tyson had gotten hold of her. If he didn't flat out kill her while attempting to mate with her, we can certainly say she wouldn't have crapped right for years after!

In wrapping up the Ron's Den part of this piece, we bring the focus back to Tyson. Yes, we can call him an asshole, a jerk, boorish, overbearing—or any number of negative terms that *we* use to describe human males who behave badly. We could even throw a "boys will be boys" in there where Tyson was concerned. The last time I counted, we have discovered a total of 53 different aggregate *atrox* dens here in Arizona. There have been more since, but 53 is enough for me to speak my mind about what Tyson's antics brought to the table. Fifty-two of those other dens did *not* have Tyson. As a result, behaviors like those just described were almost nonexistent. Tyson was the difference between Ron's Den and *everything else* I've ever seen. When I got involved with Gordon Schuett, Ron's Den fell by the wayside. The Suizo Mountains were chosen over Ron's Den for our telemetry project for many reasons, one of which was location. The Suizos lie between Phoenix and Tucson—the towns that we lived in. Gordon would have had to travel an extra two hours just to get to Harris Flats. Our other reason for choosing the Suizos over Ron's Den jibed with OxSci's desires regarding saguaros. We *also* wanted saguaros as our backdrop. My visits to Ron's Den declined sharply after 1998. The last time I saw Tyson alive was in 2006. It is only during recent times that I have made visits to Harris Flats an annual pilgrimage. On 20 March 2019, there were five *atrox* visible there. I skipped 2020 entirely, and went back for what will be my final visit on 19 March 2021. For the first time ever since finding the place, I saw *nothing* at Ron's Den this day. There were signs of nothing occupying this den everywhere I looked. There were no shed skins there, inside *or* outside of the den. Many of the smaller entrances were sealed, and soil build up had nearly closed the west gash-like entrance that we have just discussed. There was no sign of a packrat—or any recent buildup of packrat detritus. If the den is not dead, it is very close to it. Over 20 years of ever-increasing drought has caused a serious decline of all dens under watch, and the worst drought in weather history occurred in 2020.

To end on a positive note, the summer rains this year have been very kind and generous. We received nearly 12 inches of rain in July and August, and if the trend continues, our local desert *will* rebound. Nature always seems to find a way to triumph, and we can hope that the situation at Ron's Den will gradually improve. Thanks to OxSci and National Geographic, the legend of Tyson the rattlesnake will live forever. If the reader cares to see him, he plays a prominent role at the ten minute mark of *The Sonoran Desert: A Violent Eden*. The link to this exquisitely filmed documentary can be found below. Tyson may be dead, but he will live on forever in this film. He will also live forever in my notes, images, and heart. We all owe Joan Moore a debt of gratitude for finding the link for us. It's a

winner, and not just because *eye* was involved. Please peck out the link below into your favorite search engine, and prepare to be wowed. While some of it is staged, some of it is *not*: <https://www.youtube.com/watch?v=nwiRTjunCJA>

The life and times of Lonesome George

Shortly after the Beatles broke up, George Harrison produced a three-album set of his music under the title of *All Things Must Pass.* I have stopped short of going deep with this profound phrase to see where it might have originated. I can only say that I saw it first on the cover of this album set. I liked it then, and I like it now. It applies to every living organism on planet earth. Some organisms may be around a *long time*, but no living thing lasts forever.

We would have never found *anything* in Harris Flats without the presence of the stately and massive saguaro that we named Lonesome George (LG). It is interesting to note that LG was not only the beacon that guided us to two major aggregate *atrox* denning areas, but also served as a line of demarcation between *all* the distinctive types of formations that aggregate *atrox* utilize in Arizona. If we were to use the center of LG like the center of a compass, and remain within one mile of that center, every major den to the west is akin to Ron's Den. We speak of gash dens that reside in wash embankments. Everything to the east of LG is either a crevice den (like 3DPR), a mine shaft (like Fluorite Mine), or a talus den (the rocky rubble that surrounds Fluorite Mine). In short, Lonesome George was more than a landmark to us, it was the center of two different worlds. Both worlds carry the name of "Harris Flats" in my notes and articles.

I have sent the images of LG that are published here to *the* foremost authority on saguaros. I asked him a simple question, and promised I would not cite him if he answered that question. (He is either modest and overcautious to a fault, or ashamed to admit that he is a friend of mine.) It is general knowledge locally that it takes a saguaro 75 years before it starts growing its first arm. The author assumes that by now the reader has looked at Figure 1, and observed that Lonesome George has an entire army of arms. Based on the 75 years before the first arm *starts* to grow, I asked my expert if LG could possibly be 200 years old. His first answer was noncommittal. "Ask me in a hundred years." How stupid can you get? Like he would know a hundred years from now when I ask him the question again? Who wants to wait that long? I don't! I resorted to blackmail. "Yes or no, dammit! *Could this saguaro be 200 years old*? *And if you don't answer, I will say you said it was at least 500 years old—and cite you! And there isn't a damn thing you can do about it!"* My anonymous expert then replied "Yes, this saguaro is probably over 200 years old." (And hey—he could have said "no." But maybe he knew better?)

Figure 10. All things must pass. (Left) The author poses beneath Lonesome George. Note the drought-related paucity of the surrounding vegetation compared to Figure 1. Image by Robin Llewellyn, 20 March 1998. (Right) The author's son, Tim Repp, poses beside the fallen giant. 10 January 1999.

But saying that LG was over 200 years old just ain't saying it right. Let's try it this way: "Lonesome George was over TWO HUNDRED YEARS OLD!" That's better—but still ain't saying it right! Let's take a quick look at 200 years as they pertain to the history of our nation. LG was probably just a tiny zit on the landscape when the War of 1812 broke out. He may have been six inches tall during the 13 day siege at the Alamo. By the Civil War, he was probably standing over seven feet tall, and might have grown a complete arm by the time Geronimo was rounded up and his people sent off to internment as prisoners of war in Florida. By World War 1 he had probably grown his second arm, and by the end of World War 2 he was probably similar in form and structure to what we saw in 1995. But he continued to grow upward for the last 50 years of his life after WW2, reaching approximately 35 feet in height. Now I'm happy with what I was trying to say with this "200 years old" stuff. Stating that he was around for the War of 1812, the siege of the Alamo, and the Civil War is what I call "saying it right."

Arizona is the only state in the union that can boast four different deserts within its borders. To the northwest is the Mojave, and to the north of the Grand Canyon the Great Basin Desert lies. The central to southern portion of the state is dominated by the Sonoran Desert, and the Chihuahuan Desert sprawls across a vast swath of southeastern Arizona. When I took Phil Rosen—the master of desert landscapes—to Harris Flats, he immediately pronounced it to be Chihuahuan Desert. The few saguaros standing in the area were the result of the intergrade zone between Sonoran and Chihuahuan. To be sure, there are several saguaros a mile or so to the east and west of LG—and dense stands of saguaros in every cardinal direction as one goes further out—but nothing any closer than a mile to LG. I wonder if he was always alone, or simply the last man standing?

While Lonesome George's importance as a landmark ended by the spring of 1995, I visited him every time I went to Ron's Den anyway. I always considered him to be much more than a landmark. While there are bigger and more impressive saguaros out there, LG was one of a kind by virtue of his isolation. As the two images in Figure 10 show, a few of us were lucky enough to see him at the very end of his long life. At some point between 20 March 1998 and 10 January 1999, Lonesome George came tumbling down. It is well that neither I nor my son Tim were standing under him when he crashed! (It is not wise to tarry overly long when standing under any saguaro.) On 15 August 2021, my wife Dianna Repp and I headed to Harris Flats to see what might remain of Lonesome George. Keeping it short: there was *nothing*. Not a single rib, piece of cactus skin—*nothing*. During the 22 year time span between my last image of him and our visit in August of 2021, he had vanished entirely. The Chihuahuan Desert got a little bigger as a result. The last reason to return to this area is gone as well. "All things must pass," along with "And in the end, the love you take is equal to the love you make," are both pretty heavy stuff. But are those defining quotes from the Beatles as great as the quote that follows?

"This here is Roger Repp, signing off from Southern Arizona, where the turtles are strong, the snakes are handsome, and the lizards are above average."

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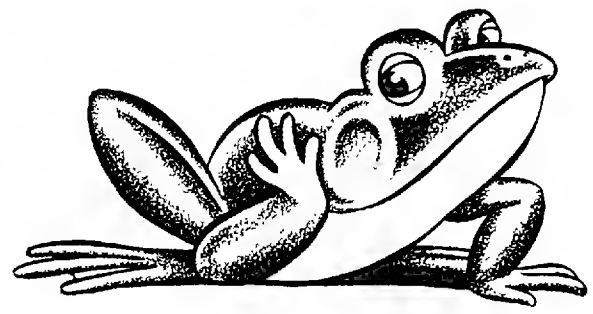
The Tympanum

Venomous Snakebite and the Covid—Differences and Similarities We Need to Know



Although snakebite venom and the Covid virus are completely different kinds of life-threatening afflictions, there are some intriguing overlaps and differences.

For example, when vaccinated, protection against Covid is near 100% and deaths are a minute 0.001% (one-thousandth of one percent) of that number. Compare that with venomous snakebite numbers. Of the 8,000 or so people who are bitten annually in the U.S. by venomous snakes and treated with anti-venom, five may die. The mortality rate is well below 0.1% (one-tenth of 1%) of all those bitten. The upshot? Mortalities among (1) those receiving the vaccine and (2) those receiving treatment in the case of snakebite, recovery is well above the 99% mark. That's the data and that's science. As we all know, mortalities are higher by far, among the unvaccinated who contract Covid.

Very likely, even the staunchest anti-vaccine person would, if bitten by a rattlesnake, opt for antivenom treatment as quickly as possible. Looking at the data, a herpetologist immediately wonders: Why would anyone who has refused to get a Covid vaccination, opt for antivenom treatment if they were snakebit? There is clearly something wrong with this picture. Why pass up a life-saving vaccination for Covid when the risks of catching Covid are way higher than being bitten by a rattlesnake? Put in context, although being struck by lightning is very rare, being bitten by a rattlesnake is far less likely. In over one year, and at the time of this writing, 615000 Americans have died of Covid, a number equivalent to the population of Albuquerque. Compare that number with the 5 people across the country that may die each year from venomous snakebite. Death from snakebite is less than 1 per every 65 million Americans annually. Those are lottery odds.

And then there is the rate of transmission of the Covid virus which is virtually everywhere versus the rarity of being bit by a rattlesnake. People infected with the Covid virus can easily transmit the bug to others, ignorant of the fact that they can be a carrier and thus contribute further to the creation of the nation-wide Covid surge. While people spread Covid far and wide, Humans cannot spread snakebite! Only the rattlesnake can do that—and that is exceedingly rare.

There is more. Vaccinations are free and every effort is being made to persuade all Americans to become vaccinated for both the health of our country and for national economic stability. We all need to step up to crush the virus, stabilize our economy and then keep it stabilized. How many companies can withstand the yo-yo performance of being open, then closed and then open as surges come and go? Retail establishments are not in business to be enforcers for wearing masks—we must take individual responsibility for that. Masks keep our businesses humming while vaccinations handle the long-term virus crush.

People become discouraged if they must go back to taking precautions when a surge takes place. The answer? Stamp out the virus. We do that by getting vaccinated. Otherwise, the unvaccinated are on the wrong side. They help keep the door open for the virus to come up with more variants with the added risk of a variant hitting the streets that's far more virulent that anything we have seen to date. Add to that: What would happen if another kind of pandemic goes global at this time? Think about it.

And then there are the economics that involve the snakebite victim. Although vaccinations are free, snakebite treatment is not! A vial of CroFab antivenom costs well over $ 3,000 and the average snakebite requires 5 to 7 vials (or more) for treatment. This leads to another question: How many victims of snakebite will object to taking high-priced antivenom--even though their survival odds are enormously better than if they contract Covid? Or, would more people take the Covid vaccination if they had to pay several hundred dollars for it? In fact, any one bitten by a rattlesnake will very likely opt to take the antivenom treatment regardless of the personal financial disaster that they may face! Another related question: How many vaccination "nay-sayers" have dogs, and make certain that their pets are vaccinated against snakebite? Furthermore, if snakebite immunization existed for humans (which it does not), how many Covid vaccination opponents would take a rattlesnake vaccination if one were available—even though the likelihood of garnering a venomous snakebite is minuscule?

Another very important reason to get immunized involves a lifetime of serious impairments. Recovery from the disease is only part of the story. Potentially devastating but seldom mentioned are the long-term to lifelong side effects that can plague a survivor of Covid or snakebite. Once recovered from the immediate effects of snakebite, a victim may require some amputation or can be left with a withered finger or limb. That's bad enough but with Covid the impact can be much worse. A recovered Covid survivor can be left with a lifetime of dependency on life-support systems due to damaged lungs, heart, kidneys, brain and more. My only venomous snakebite involved a baby diamondback that managed to sink one fang into my right index finger. Sixty-plus years later the finger still does not function normally and is subject to partial immobility when cold. I was extremely fortunate to keep this finger, since amputation was planned to take place a week later. I would hate to have faced the gambles that come with a Covid infection, which can be far worse.

So what's the main difference between rattlesnakes and the coronavirus? Intent. Venomous snakes intend to avoid us. A venomous snakebite may even be dry. If they were out to "get us," I would have been a rattlesnake victim decades ago. On the other hand, the mindless coronavirus thrives by infecting as many people as possible. The result? I got my shot and was one of the first to do so.

Get the vaccine. What have you got to lose? The unvaccinated now own the pandemic. The message: Do it. Get the shot.

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Herpetology 2021

In this column the editorial staff presents short abstracts of herpetological articles we have found of interest. This is not an attempt to summarize all of the research papers being published; it is an attempt to increase the reader's awareness of what herpetologists have been doing and publishing. The editor assumes full responsibility for any errors or misleading statements.

KNOW THINE ENEMY

J. E. Hammond et al. [2020, Journal of Herpetology 54(4): 480-484] note that most animals have predators, and therefore must balance the needs of foraging and mating with those of shelter and safety. Many species rely on chemosensory cues to identify predators and organize defenses specific to particular types of predators. A large body of research in this area has focused on lizards and snakes because they have heightened chemical senses and have been shown to identify predators using chemical cues alone. The authors designed an experiment to examine the antipredator behavior of a common desert-dwelling nocturnal lizard, the banded gecko (*Coleonyx variegatus*), towards snake predators that use different hunting techniques: active-hunting glossy snakes (*Arizona elegans*) and ambush-hunting rattlesnakes (*Crotalus cerastes*). They exposed banded geckos to chemical cues from these two predators and measured a series of behavioral responses including tail displays, time spent investigating chemical cues while actively moving, and time spent in refugia. Geckos exhibited clear antipredator behaviors toward both snakes but spent more time actively moving in response to glossy snake cues. Because rattlesnakes use ambush strategies to capture prey whereas glossy snakes are active searchers, remaining in place while assessing rattlesnake cues is probably less risky than when assessing glossy snake cues. The findings indicate that banded geckos can not only discriminate among different predatory snake species based on chemical cues alone, but they also appear to adjust their antipredator responses in a predator-specific manner.

SURVIVAL RATES IN DUSKY RATTLESNAKES

J. L. Jaramillo-Alba et al. [2020, Herpetologica 76(1):43-52] note that survival rate is one of the most poorly characterized components of the life history of many species of reptiles, especially snakes. Reproductive activity can increase the risk of mortality. The authors examined whether sex-specific reproductive costs affect the survival probability of a viviparous rattlesnake, *Crotalus triseriatus*, in central Mexico from 2015 to 2018. They used a multimodel inference framework to test two hypotheses: (1) female survival probability should decrease during the late-gestation and birthing period, when females are less mobile and try to achieve stable body temperatures by behavioral thermoregulation; and (2) male survival probability should decrease during the mating season, when males are more actively searching for potential mates. The data did not support these hypotheses. Mean (±1 SE) monthly survival probability of both males and females was 0.96 ± 0.01, and recapture probability was 0.11 ± 0.01. Annual survival rate was 0.72 ± 0.12. Monthly estimated mean adult population size varied from 16 to 71 adult rattlesnakes. Survival probability was positively correlated with body size. The reproductive costs could have been obscured by the fact that females do not reproduce every year and, therefore, the demands of the mating season are not as tightly linked to survivorship as had been hypothesized.

RIVER TURTLES AND ONE DAM LAKE

W. Selman [2020, Chelonian Conservation and Biology 19(2): 186-196] notes that the impacts of human modifications of rivers and associated fauna are well documented, especially following the construction of impoundments. In the Pearl River system of Mississippi and Louisiana, two endemic *Graptemys* species are found (*G. oculifera*; *G. pearlensis*), but little is known of their densities in urban segments near Jackson, Mississippi, although both are species of conservation concern. The author used spotting scopes and binoculars to complete replicated basking surveys for both *Graptemys* species during the summers of 2017 and 2018 in five equidistant segments of the Pearl River and nearby oxbow lakes. Basking densities for both species were generally higher in river segments upstream and downstream of Jackson compared to middle segments. *Graptemys oculifera* were found in greater densities than *G. pearlensis* in all segments (14–69 times higher). *Graptemys oculifera* was found in four of the six oxbow lakes surveyed, but mean densities decreased tenfold compared with river segments; *G. pearlensis* was absent from all oxbow lakes. Densities for a generalist turtle species, *Trachemys scripta*, increased 35 times in oxbow vs. river habitats. The middle three survey segments (~ 15.9 river kilometers) are inclusive of a proposed river impoundment project—the One Lake Project—for flood control and economic development. Estimates of direct and indirect impacts of this project are sizeable for *G. oculifera* (direct impact: 1684; indirect: 2129) while estimates for *G. pearlensis* are lower (direct: 88; indirect: 219). The One Lake Project would surely alter existing riverine processes and will favor generalist turtles such as *T. scripta* that prefer nonflowing lake settings at the expense of riverine *Graptemys* species. The One Lake Project would be a major setback to both *Graptemys* species in and around the project area and would negatively impact the recovery potential of both species.

SLIDERS IN GERMANY

C. Schradin [2020, The Herpetological Bulletin 154:1-7] notes that the European Union categorizes pond sliders (*Trachemys scripta*) as invasive species for which all member countries have to develop an action plan. To date it has been assumed that the climate in Germany is too cold for *T. scripta* to survive or reproduce. Data collected annually from 2016 to 2020 show that the population of exotic pond turtles in an oxbow lake (Althrein of Kehl, Germany) did not decrease but increased. In addition, the diversity of species released was found to be high, five other exotic species in addition to *T. scripta* were observed. The population of *T. scripta* in particular appears to be increasing, with no indication of high mortality due to cold winters and apparently regular successful reproduction (hatchlings observed in four of five study years and caught in two years). The current action plan in Germany for *T. scripta* will have to change if potential negative impacts are to be avoided. Other west and central European countries might also have to modify their action plans accordingly.

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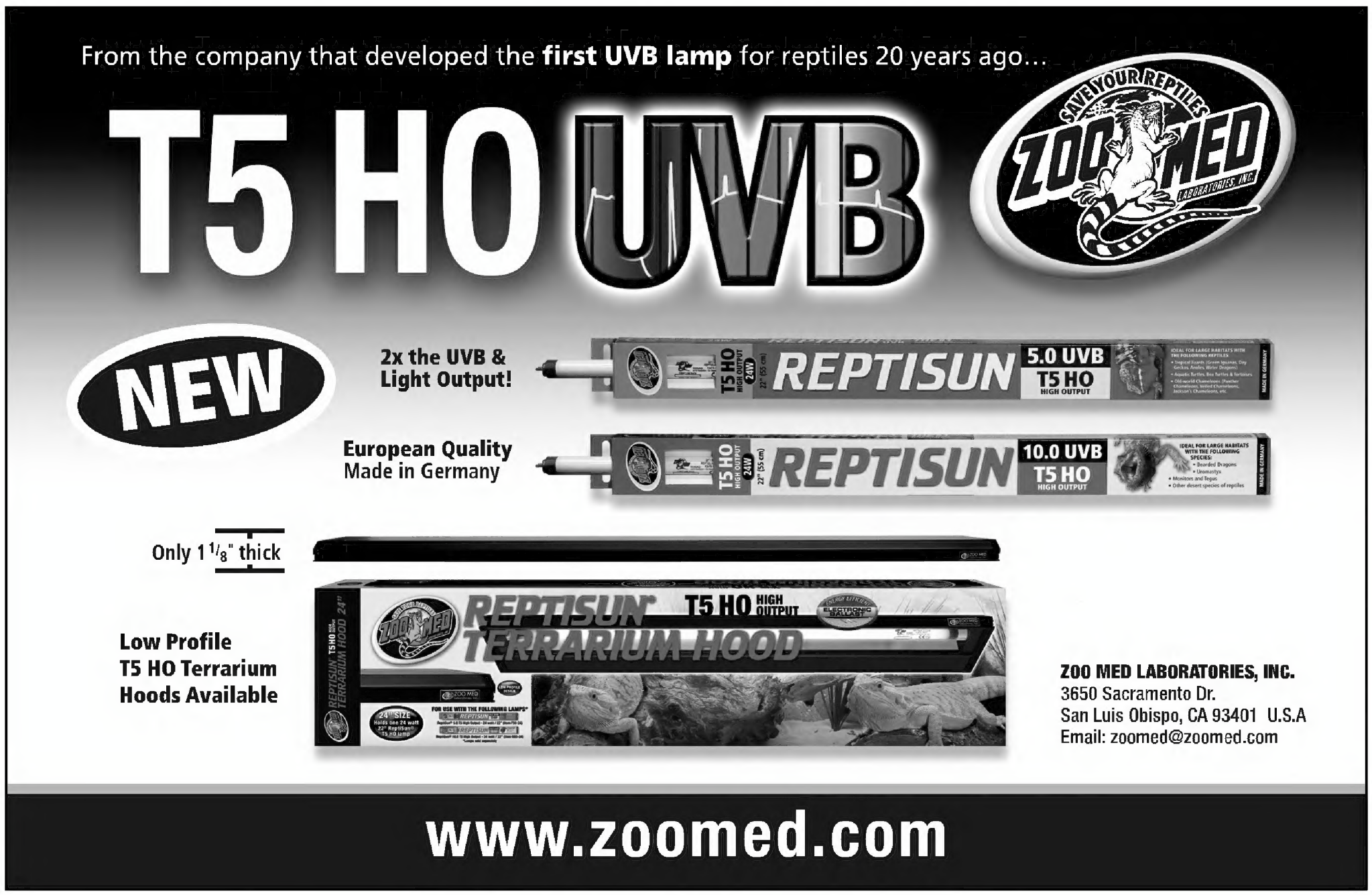
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UPCOMING MEETINGS

Until in-person meetings again become possible the Chicago Herpetological Society will be holding monthly general meetings online via Zoom webinar. A notification will be sent by email to all members who have supplied us with an email address. As has been our custom for over 50 years, the meetings will be held on the last Wednesday evening of each month. A program for the September webinar has not yet been confirmed.

It is possible that we may be able to resume live meetings on October 27. Please check the CHS website or Facebook page for announcements.

Information about attending a Zoom webinar can be found here:
<https://support.zoom.us/hc/en-us/articles/115004954946-Joining-and-participating-in-a-webinar-attendee->

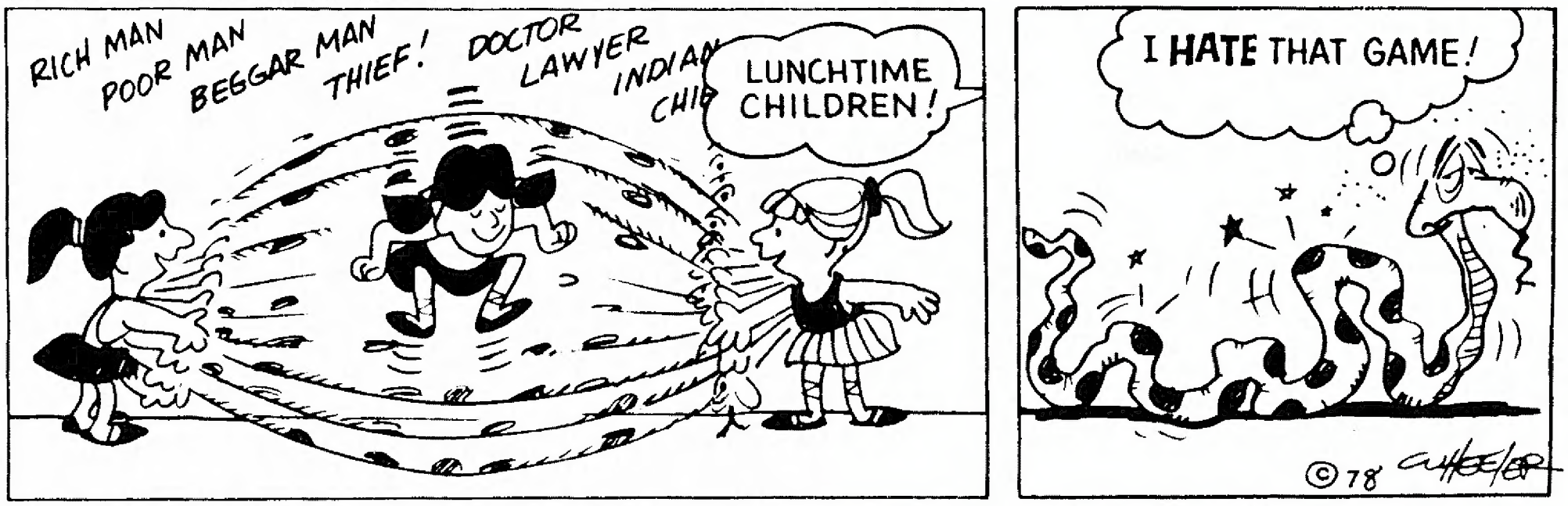
Board of Directors Meeting

Are you interested in how the decisions are made that determine how the Chicago Herpetological Society runs? And would you like to have input into those decisions? The next board meeting will be held online. If you wish to take part, please email: mdloogatch@chicagoherp.org.

MIDWEST PARTNERS IN AMPHIBIAN AND REPTILE CONSERVATION

Midwest PARC will be holding a virtual meeting October 1–2. The theme will be "Changes in Amphibian and Reptile Populations throughout the Midwest." If you are interested in attending, details can be found on their website:
<https://www.mwparc.org/copy-of-products>

THE ADVENTURES OF SPOT



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